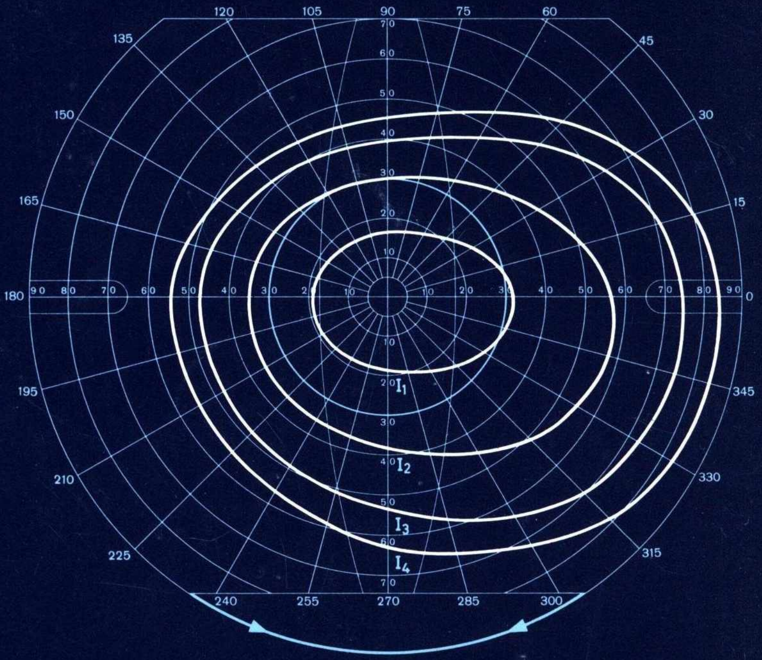


Goldmann Perimeter 940

Instructions for use

HAAG-STREIT AG

Ophthalmological Instruments
3097 Liebefeld/Switzerland

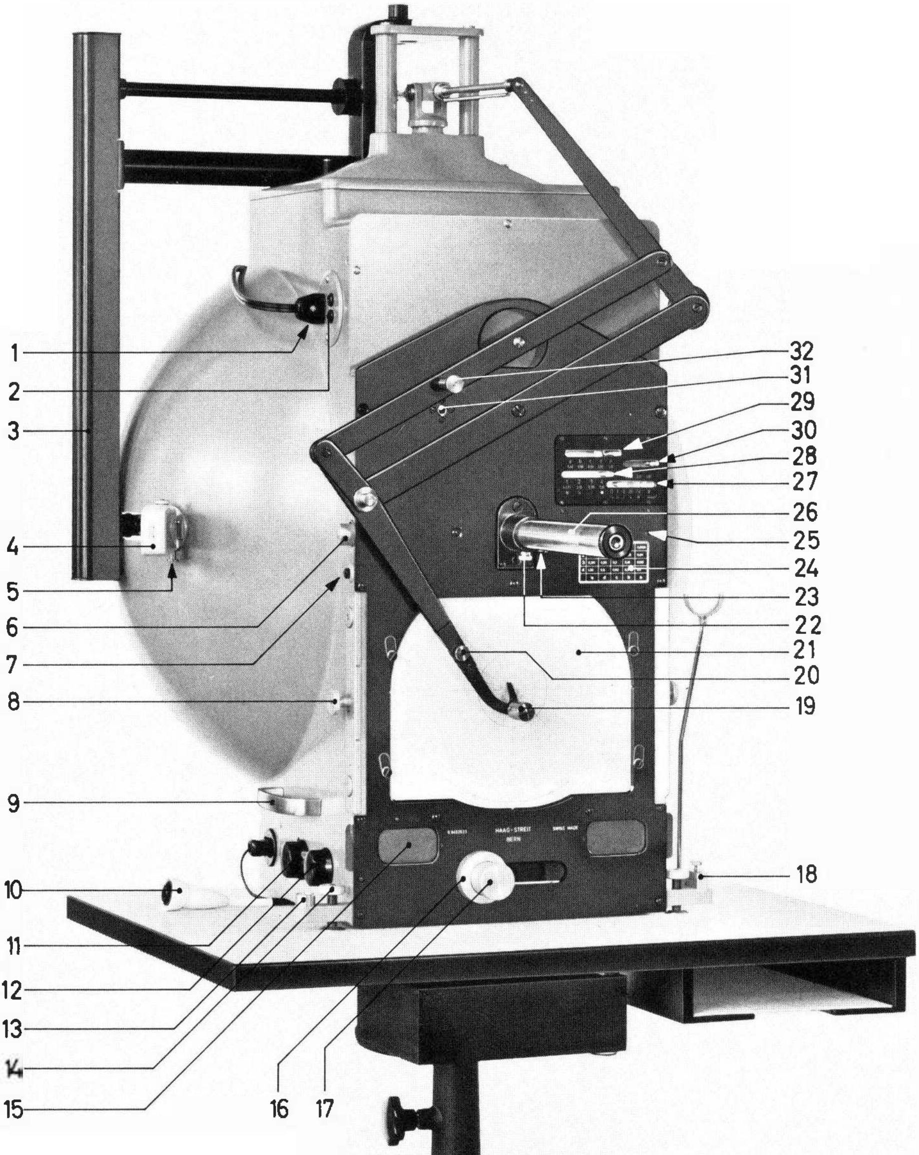

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
32
31
29
30
28
27
26
25
24
23
22
21
20
19
18
HAAG-STREIT
BERN
SWISS MADE

Fig. 1

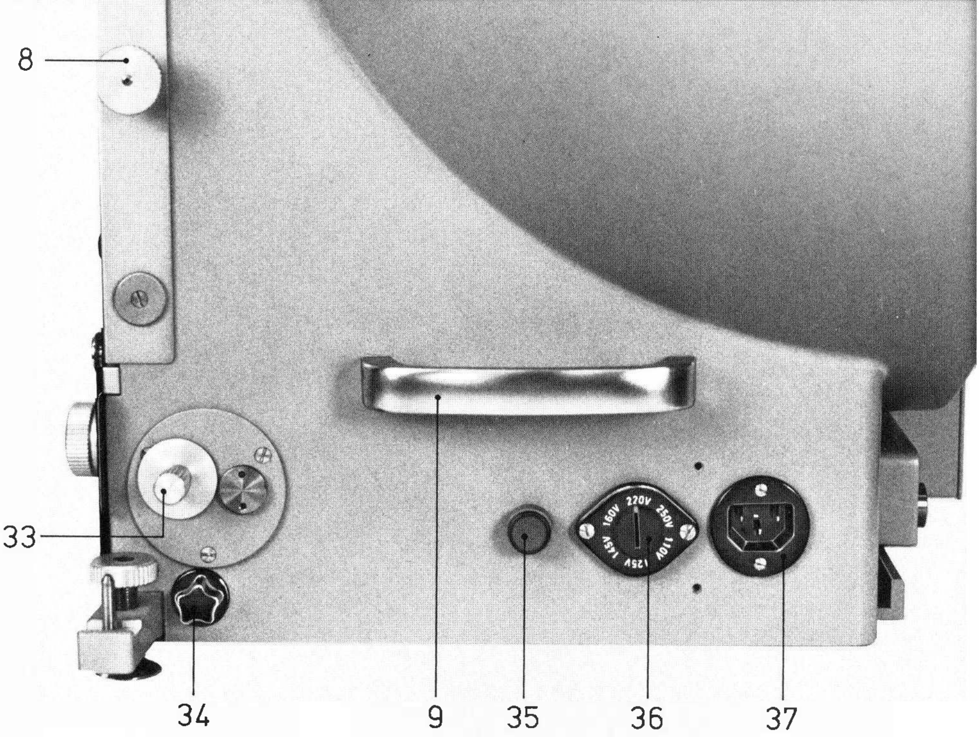

8
33
34
9
35
36
37
220V
250V
110V
125V
145V
160V

Fig. 2

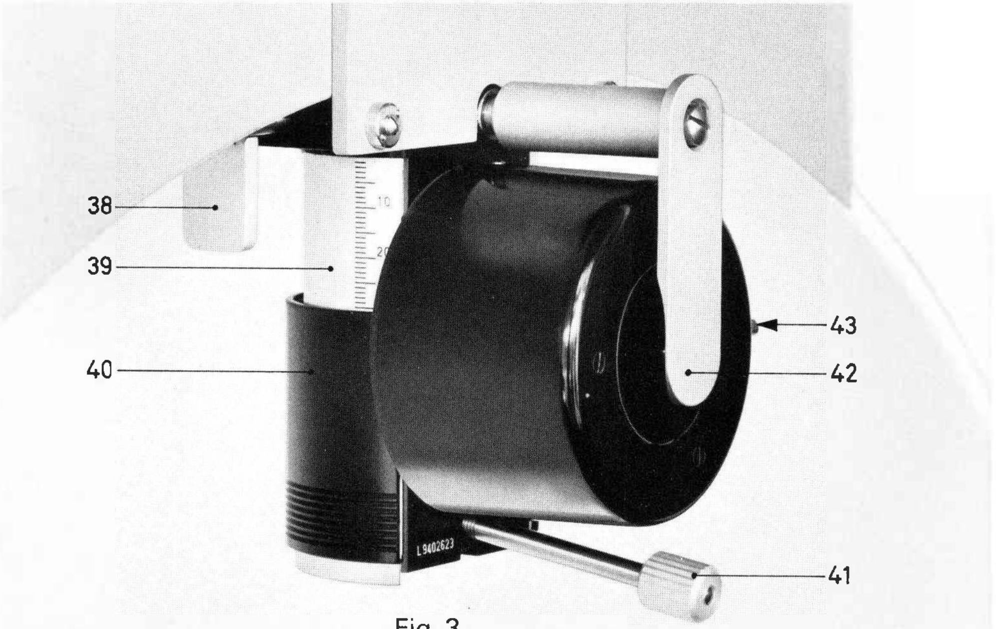

38
39
40
10
20
43
42
L 9402623
41

Fig. 3

Perimeter 940

Terms Figure 1	1	Socket with cable for main bulb
	2	Left-hand socket for central scotoma device
	3	Projector
	4	Lightmeter
	5	Handle for photometer screen
	6	Bulb for illumination of the lightmeter scale
	7	Push-button contact for 6
	8	Knurled knob for chart plate
	9	Handle
	10	Push-contact with cable for buzzer signal
	11	Resistance for main bulb
	12	Resistance for chart illumination
	13	Spirit level
	14	Foot screws
	15	Slide in front of bulbs for chart illumination
	16	Knurled knob for lateral movement of the head-rest
	17	Knurled knob for vertical movement of the chin-rest
	18	Plug device for holder of correcting lenses
	19	Handle of pantograph
	20	Pantograph coupling
	21	Chart plate
	22	Tightening screw for telescope
	23	Handle for large fixation point
	24	Table for filter combinations on 940-K7
	25	Telescope
	26	Checking aperture
	27	Handle for diaphragms
	28	Handle for grey filters 1.00, 0.315, 0.10, 0.0315
	29	Handle for grey filters 1.00, 0.80, 0.63, 0.50, 0.40
	30	Handle for grey filters 1.00, 0.01, 0.0001
	31	Centring socket
	32	Centring pin
Terms Figure 2	8	Knurled knob for chart plate
	33	Shutter
	34	Fuse
	35	On-off switch
	9	Handle
	36	Voltage selector
	37	Mains supply
Terms Figure 3	38	Flanges
	39	Scale
	40	Sliding diaphragm
	41	Holding screw for plug
	42	Spring handle for lamp cover
	43	Plug for cable to main bulb

Instructions for use

Alignment of the instrument

For the projector 3 to swing back automatically into the protected position by the sphere, the instrument must be leveled. This is done by turning both foot screws 14 until the spirit level 13 beside the left screw shows the instrument correctly balanced.

Inserting the charts

A half-turn of the knurled knobs 8 right and left of the chart plate 21 lifts the plate clear of the frame, so that the chart can be inserted. The chart's position is vertically correct when line *e* on its bottom edge is exactly in the V-notch of the frame. The lateral marks *g* on the chart should be level with the two lateral V-notches. The chart is secured by turning the two knurled knobs 8. Its position can be slightly adjusted by hand through pressure on the plate.

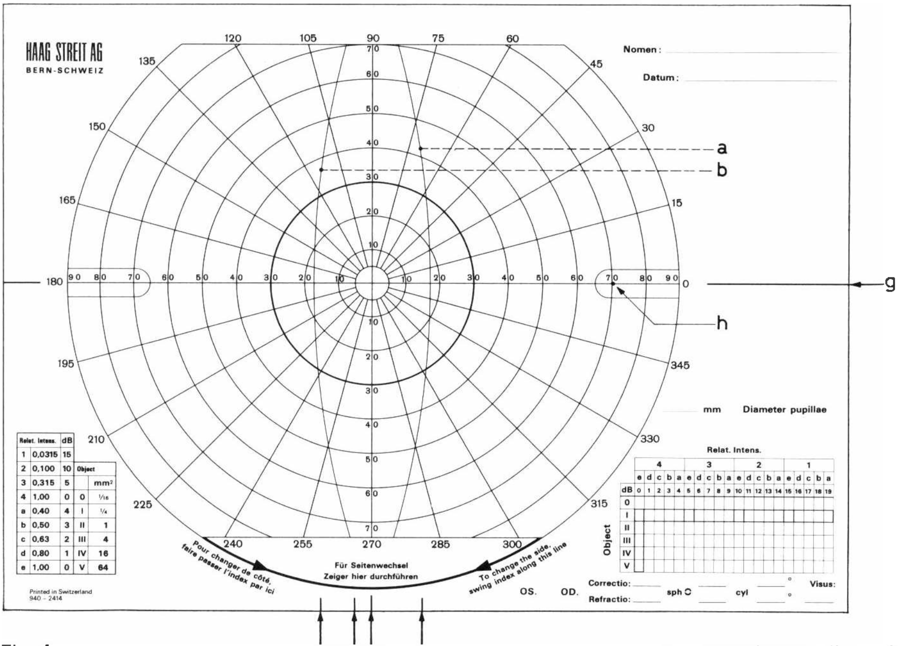


Fig. 4

Normal chart, unilateral

When a fixation light projector is employed, the line *d*, 5° from the centre line, is used as the guide. This should then be aligned with the V-notch. 15° to the right and left are lines *c* and *f*, used for examinations with the central scotoma device. *h* is the point of orientation for holding the projector when adjusting the brightness of target and sphere.

Besides the normal unilateral chart shown in fig. 4, charts of the same size printed on both sides are available, with an impression for fundus drawing according to Amsler/Dufour on the reverse. If a smaller size is preferred for filing etc., the fields of both eyes may be recorded on the double chart (size 147x210 mm).

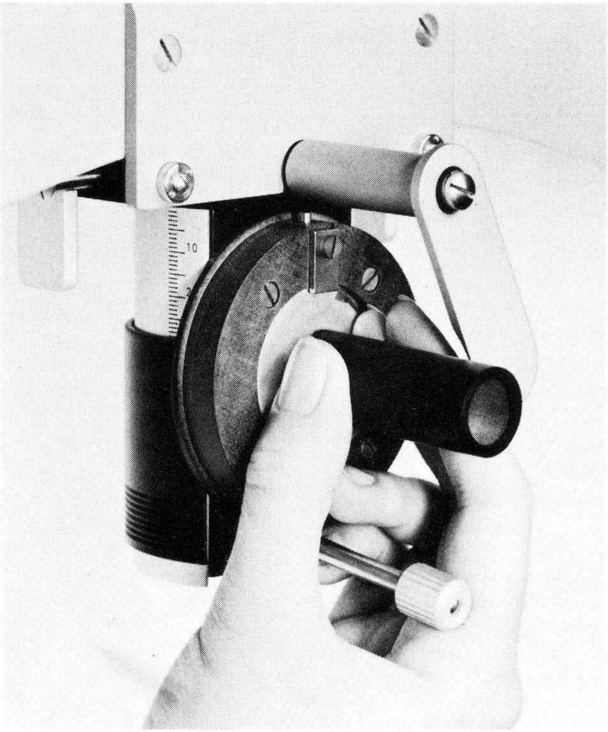


Fig. 5

Exchanging the bulbs

The main bulb 6 V, 4.35 A, with centring base should be changed or turned 180° when luminance of the largest and brightest test target does not reach 1000 asb. at the 0-position of the rotary resistance 11. The bulb can be kept longer if it is turned 180° after every 20–30 hours of use.

In changing the bulb, the black lamp cover has to be removed first. With the left hand, pull the spring lever 42 clear of the lamp cover and swing it to the side. With the right hand, remove the lamp cover. The main bulb is now accessible. Using the black rubber tube, turn the bulb anti-clockwise and take it out (fig. 5). Put in the new bulb, turning it until the little screw on the centring base hits a stop.

The two small 6 V, 5 W bulbs with bayonet sockets, for illuminating the chart, are reached by removing the slides 15 in front of them. A similar bulb 6 illuminates the lightmeter scale.

Moving the projector

The projector should be guided by the handle 19 at a constant rate of about 2° a second across the surface of the chart, from invisible to visible.

If the projector is to be moved from one half of the field to the other, it can only be done by lightly guiding the index of the handle approximately along the line arrowed at the bottom of the chart. Line *a* indicates the limit of the target's mobility in the left half and line *b* its limit in the right half of the visual field (fig. 4). The part between the two arcs can be plotted from either side. The isopters should be marked on the chart with a sharp lead or coloured pencil, using the index above the handle 19. The table on the lower right-hand side of the chart provides space to record the examination and target data.

Adjusting the size and brightness of the target (fig. 6)

In the back wall there is lever 27 for regulating the diaphragms and levers 28, 29 and 30 for interposing the grey filters, No. 30 only on Perimeter 940-ST.

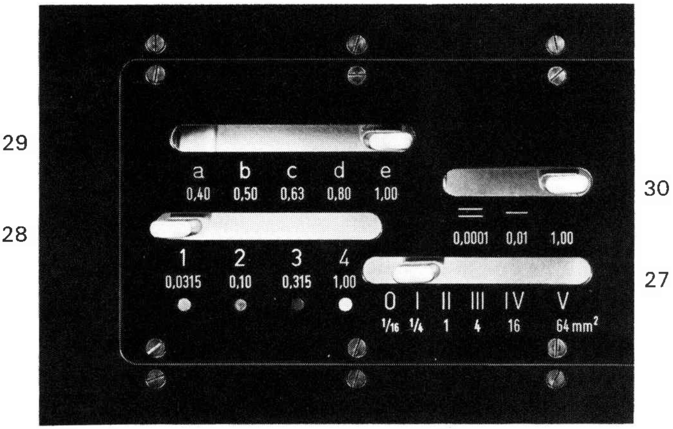


Fig. 6

Lever 27 engages diaphragms for targets in six different sizes, i.e. 64, 16, 4, 1, $^1/_4$ and $^1/_{16}$ mm^2.

With the two sets of grey filters 1–4 and a–e logarithmic decadal gradation of the target luminance is obtained. It can be expressed either in transmission numbers D=1.0, 0.8, 0.63, 0.5, 0.4, 0.315, 0.25, 0.2, 0.16, 0.125, 0.1 or in decibel, d. B = logarithmic decadal unit 0 1 2 3 4 5 6 7 8 9 10 . . . . On brand-new Haag-Streit perimeters D = 1.0 and 0 d. B corresponds to a luminance of 1000 asb.

The filters of the first set can be interposed with lever 28, those of the second set with handle 29. By combining the logarithmically graduated filters the luminance of the target can be changed in fine steps, thus allowing any required number of isopters to be established.

Table for grey filter combination in the Perimeter 940-K7:

1	0.0315	0.025	0.02	0.016	0.0125
2	0.100	0.08	0.063	0.05	0.04
3	0.315	0.25	0.2	0.16	0.125
4	1.00	0.8	0.63	0.5	0.4
	e	d	c	b	a

Lever 30 brings into play the plate containing grey filters with transparencies of 1.00, 0.01 and 0.0001, found on the Perimeter 940-ST. Filters with transparencies of 0.01 and 0.0001 are used in perimetry with greatly reduced luminance of the sphere and large targets.

Adjusting the telescope

The eyepiece of the telescope 25 can be drawn out to a greater or lesser extent, according to the refraction of the examiner, so that the reticule and the patient's eye are clearly visible. The reticule is subdivided for measuring the width of the pupil in millimeters.

Obtaining normal brightness of target and sphere

The main incandescent lamp—6 V, 4.35 A—serves as the light source for both the sphere and the target projected by the projector 3. Correct adjustment of the luminance of both is of utmost importance for ensuring the instrument's accuracy in examinations. For obtaining proper luminance of the target, the procedure is as follows: the index at the end of the pantograph is guided to the little circle at 70° on the right-hand side of the chart (point *h,* fig. 4). In this position, the centring pin 32 lies directly over the centring socket 31. Lock the pantograph system by inserting the pin. The pencil of light from the projector lens will then fall fully on the light-sensitive cell of the lightmeter 4. Using the largest and brightest target—levers 27 to 30 turned as far as they will go towards

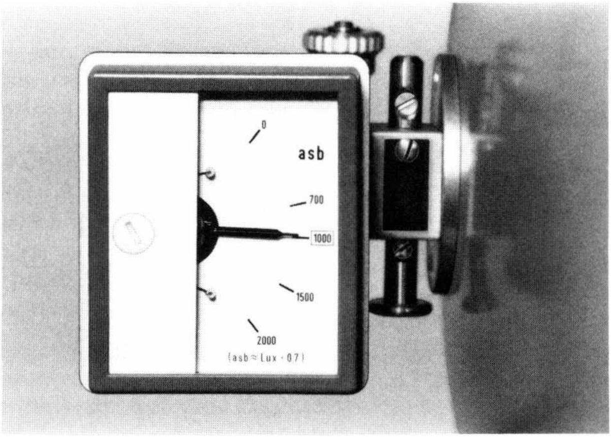


Fig. 7

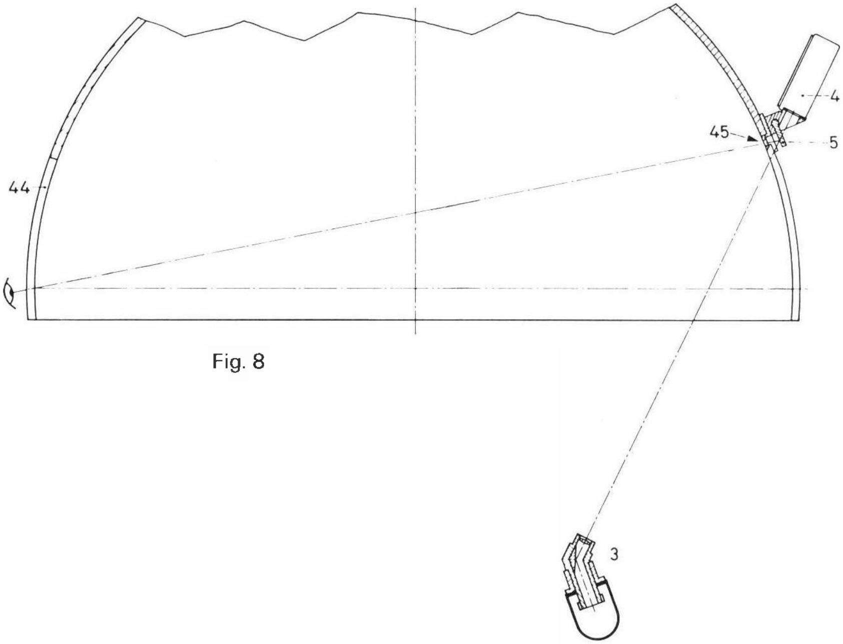


Fig. 8

the right—normal luminance of 1000 asb. is then obtained by turning resistance 11 (fig. 7). For reading the lightmeter scale push the red button at the rear; otherwise there will be no pointer deflection. Pushbutton 7 works the bulb 6 which illuminates this scale.

To obtain a 31.5 asb. luminance of sphere, handle 5 is pulled downwards, putting the white photometer screen in the light path of the target, and grey filter 0.0315 is interposed, producing a luminosity of 31.5 asb. on the photometer screen. As shown in fig. 8, look through aperture 44 to gauge the brightness of the sphere on the photometer ring 45 at the far side, and by moving the sliding diaphragm 40 up or down, adjust the sphere's brightness to that on the photometer screen 5 (fig. 9). The scale on the lamp housing is not an indication of the brightness in the sphere, but is useful in certain cases.

Exact adjustment of the luminance of target and sphere should be made before every examination, when the patient is already sitting in front of the perimeter. The lightmeter should be protected from constant exposure to strong light.

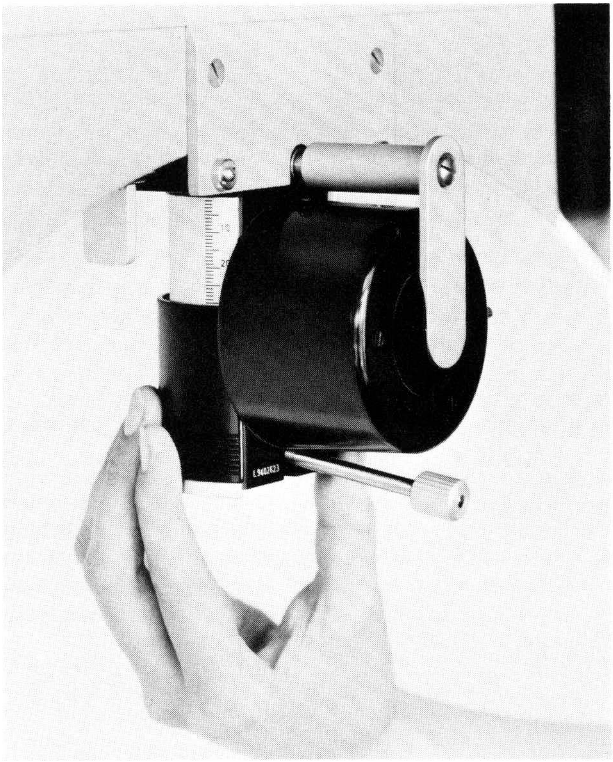


Fig. 9

Shutter device for target control

The shutter handle 33 can be either pressed down or turned by 180°. Depending on its position, the target is either projected or covered, which is immediately apparent in the darkened examination room. When the target is being projected in the sphere, light is visible through the checking-aperture 26. Otherwise, the target is shuttered.

Conversion of units for illuminance and luminance

a) Units for illuminance

Name of unit Symbol	lux lx	footcandle fc
1 lux =	1	0.0929
1 footcandle =	10.76	1

b) Units for luminance

Name of unit Symbol	nit nt	stilb sb	apostilb asb	lambert L	foot-lambert fl
1 nit $= 1 \frac{cd}{m^2}$ =	1	0.0001	3.141	0.000314	0.292
1 stilb $= 1 \frac{cd}{cm^2}$ =	10000	1	31415	3.141	2920
1 apostilb $= \frac{1}{\pi} \frac{cd}{m^2}$ =	0.318	0.0000318	1	0.0001	0.0929
1 lambert $= \frac{10^4}{\pi} \frac{cd}{m^2}$ =	3180	0.318	10000	1	929
1 footlambert =	3.426	0.0003426	10.76	0.001076	1

1 candela = 1 cd = unit for luminous intensity

c) Luminance of the target

The luminance of the target can be calculated from the illuminance when the *factor* of diffuse reflection (albedo) is known.

Example: albedo = 0.7
$1430\ \text{lux} \mathrel{\widehat{=}} 1430 \cdot 0.7 = 1000\ \text{asb}$

The lightmeter supplied with the perimeter is calibrated in asb based on albedo 0.7 of the sphere.

Examination

The apparatus should be installed in a completely dark room, entirely separate if possible from the doctor's normal consulting room. This obviates to a great extent obstacles to an accurate result such as inconstant illumination of the background and distraction of the patient. Besides a certain degree of intelligence, great attention is required of the patient, and anything which might divert him from active cooperation should be avoided.

The length of the examination should be varied according to the general disposition of the patient. In the course of the examination, the accuracy of the isopters plotted should be verified. If great differences are found, examination should be interrupted for a rest. The examination of one eye should not be stretched to more than 15 minutes. A repeat-examination should be arranged for another day if the first does not produce unequivocal results.

Make sure that the patient is sitting comfortably at the apparatus and that the eye which is not being examined is completely covered by the opal occluder. The patient can then keep both eyes open and in the same state of adaptation.

The patient should signal the appearance of the target by sounding the buzzer. This is preferable to speaking, which would make the patient move his head, decentring the eye, which is liable to cause especial difficulties in examining the central visual field. Furthermore, the inside of the sphere cannot remain clean if the patient speaks. If the patient is given an explanation of the procedure in simple terms, examination becomes considerably easier. When the target first appears in his visual field, the patient is inclined to look away from the fixation point and forgets to sound the buzzer. If, the first time his gaze wanders from the fixation point, the patient is immediately recalled to the centre, he feels he is being observed, whereupon the rest of the examination usually proceeds without difficulty. Good fixation by the patient is indispensible if exact results are to be achieved.

With a given background luminance, the position of the isopters in kinetic-quantitative perimetry depends not only on the size and luminance of the target, but also on the speed at which the target is moved. The examiner has the additional duty of keeping this speed constant. It should be adjusted to the patient's reaction time. The examiner can best gauge the patient's fixation and reac-

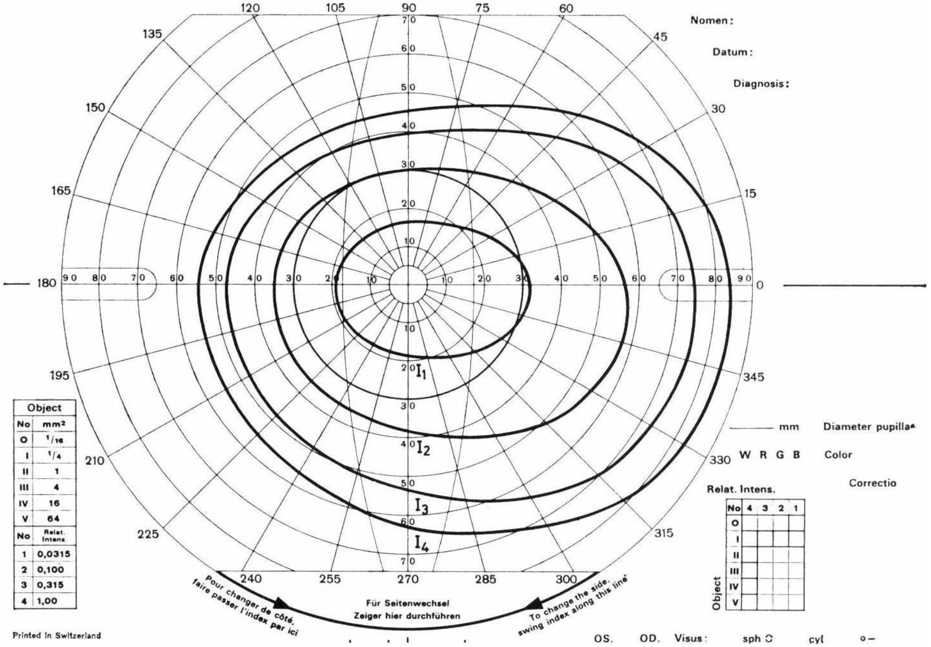
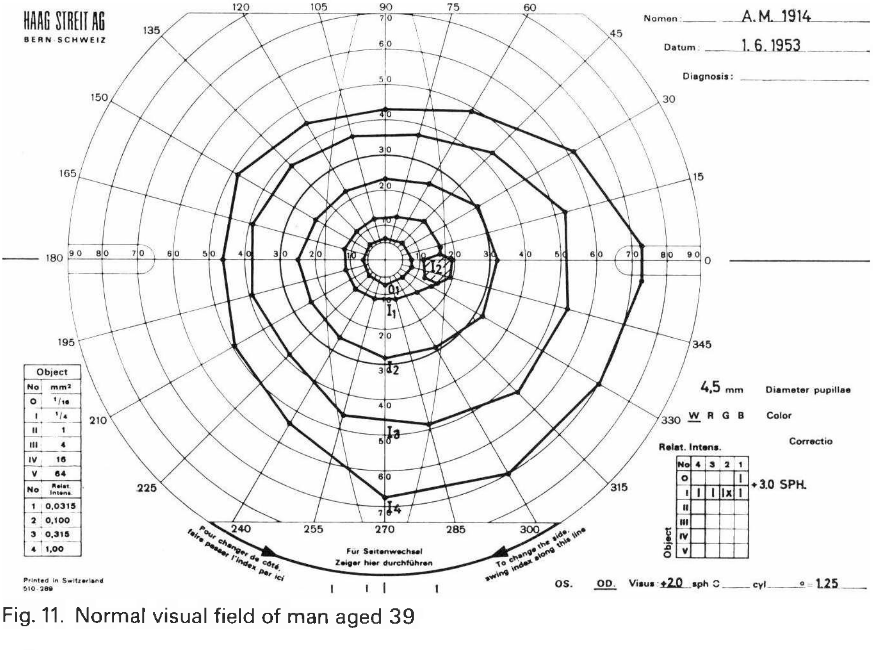


Fig. 10. Average results of 20 normal persons, aged 20–30



Nomen: A.M. 1914

Datum: 1. 6. 1953

4,5 mm Diameter pupillae

+3.0 SPH.

OD. Visus: +2.0 sph cyl ° = 1.25

Fig. 11. Normal visual field of man aged 39

tion time while examining the blind spot. Even with a proper target, the blind spot will appear smaller than it actually is if the fixation is bad; and larger than it is if the reaction is slow. The nasal border of the blind spot usually lies at about 12° from the centre. To record the isopters, it is normally sufficient to determine the threshold along 8–12 points, i.e. every 30°–45° (fig. 11 and 12).

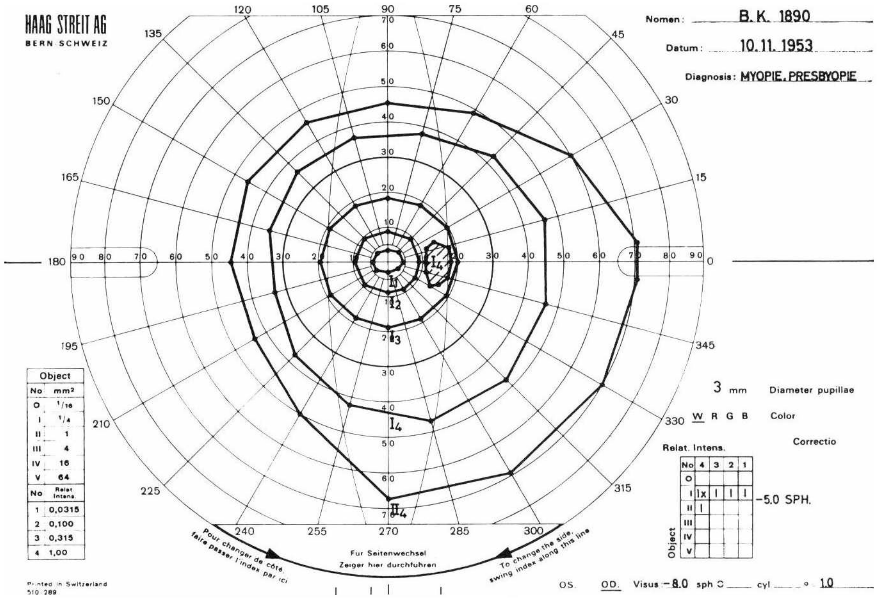
Where, however, examination reveals a constriction of the isopters, its borders should be determined at every 2°–3° (fig. 13 and 16).

In every case, examination of the whole visual field with the various targets is necessary. Only then can a detailed opinion be formed of the state of the visual field. It is not enough to determine only the peripheral field. There are very few diseases of the visual apparatus which cause a change exclusively to peripheral vision. We know of numerous diseases whose initial stages lead to changes in the medial and central visual field, while the limits remain normal and give rise to no suspicion, e.g. glaucoma, cerebral tumor, retrobulbar neuritis, detachment, tumor of the chorioid, chorioiditis, etc. (fig. 13, 14, 15 and 17).

Which eye to examine first? It is best to begin with the sounder eye, the one with the better visual acuity. After a short interval, during which the isopters are marked in on the chart, the other eye should be examined. At repeat-examinations the diseased eye may be tested first. Otherwise, the worse-affected eye should then be checked first when there is a suspicion of simulation or aggravation. If simulation is suspected because of a concentric constriction of the visual field of one or both eyes, an attempt to bring this to light may be made through examination of the binocular field of vision.

It has been found useful to register the width of the pupil at examination luminance. The change of isopters as a result of medication, altering the width of the pupil, often seems to indicate a non-existent improvement or deterioration of the visual field.

Care must also be taken that, in examining the central and medial visual field, any anomalies of refraction are given optimal correction.



Nomen: B. K. 1890

Datum: 10. 11. 1953

Diagnosis: MYOPIE, PRESBYOPIE

3 mm Diameter pupillae

W R G B Color

Correctio

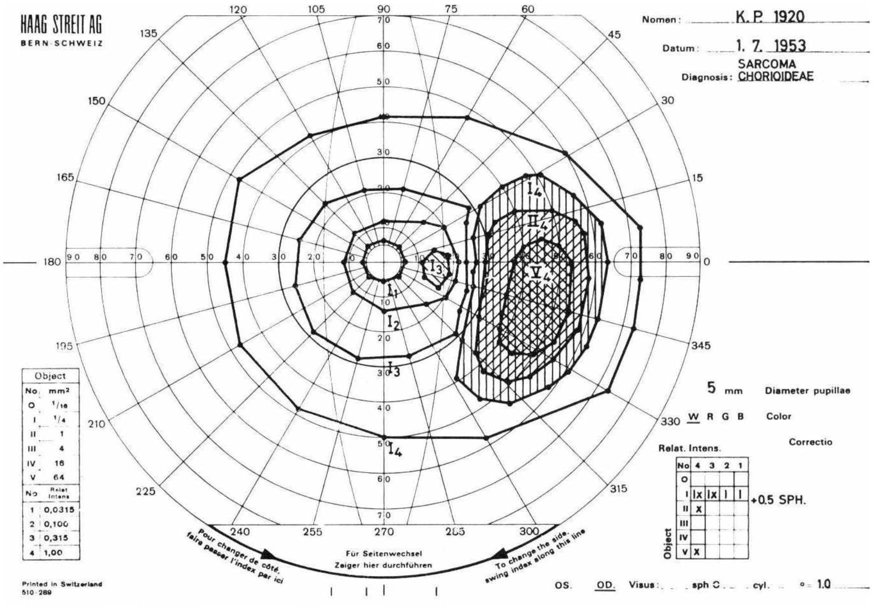
Object	
No	mm²
O	1/16
I	1/4
II	1
III	4
IV	16
V	64
No	Relat. Intens.
1	0,0315
2	0,100
3	0,315
4	1,00

Relat. Intens.

No	4	3	2	1	
O					
I	Ix	I	I	I	−5.0 SPH.
II	I				
III					
IV					
V					

OS. OD. Visus: −8.0 sph ○ ___ cyl ___ ○ = 1.0

Fig. 12. Normal visual field of man aged 63



Nomen: K. P. 1920

Datum: 1. 7. 1953

Diagnosis: SARCOMA CHORIOIDEAE

5 mm Diameter pupillae

W R G B Color

Correctio

Object	
No	mm²
O	1/16
I	1/4
II	1
III	4
IV	16
V	64
No	Relat. Intens.
1	0,0315
2	0,100
3	0,315
4	1,00

Relat. Intens.

No	4	3	2	1	
O					
I	Ix	Ix	I	I	+0.5 SPH.
II	X				
III					
IV					
V	X				

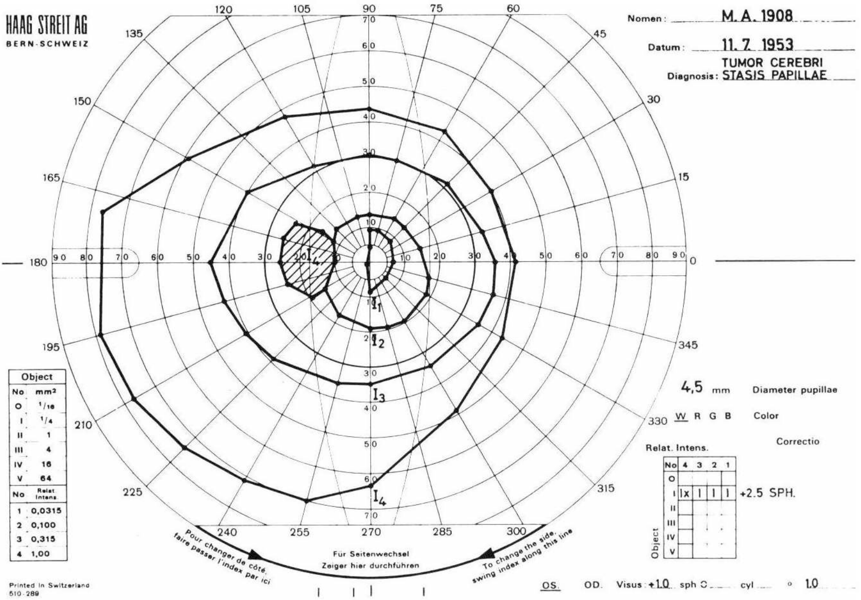
OS. OD. Visus: ___ sph ○ ___ cyl. ___ ○ = 1.0

Fig. 13. Visual field in a case of tumor chorioid

Procedure for examination

(kinetic-quantitative perimetry or isopter perimetry)

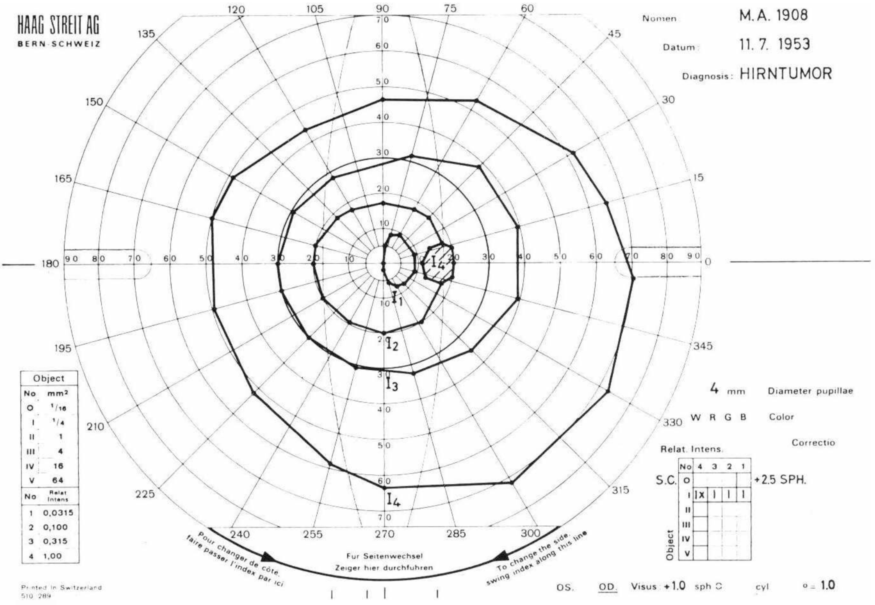
1. Examination of refraction of both eyes for distance. Determine optimal correction with lenses for each eye to distance of 30 cm = 12 in.
2. Adaptation of the patient at the illuminated perimeter for 2–3 minutes. During this time:
3. Approximately adjust the headrest. For the examination of the right eye the headrest is on the patient's left.
4. Cover the eye that is not to be tested with the opal occluder.
5. If necessary, fix the patient's head on the headrest with the headband. Care should be taken that the patient is sitting in a comfortable position.
6. Gauge the perimeter first with the lightmeter, then with the photometer screen. (See 'Obtaining normal brightness of target and sphere', page 7, chapter 'Perimeter 940'.)
7. Explain the procedure to the patient in simple words that are easy to understand, e.g. 'Please look straight ahead at the black point in the middle and keep the eye fixed on the mirror' (for patients with good sight). If the sight is slightly impaired, the patient should be asked to look fixedly at the somewhat larger moveable mirror. 'Please press the buzzer the moment you see a white spot appear on the periphery'. The instruction to maintain a good fixation—to keep the eye on the mirror—is repeated at the beginning of the examination. If the patient does not see the black spot, direct the eye into the desired position by commands, or perform the examination with the central scotoma device.
8. Insert the perimeter chart.
9. The examiner positions himself in front of the perimeter with the telescope 25 at eye-level. One eye constantly supervises the fixation of the patient's eye, the other watches the index of the pantograph as it is guided over the chart.
10. Centre the patient's eye exactly by turning the two knurled knobs 16 and 17.
11. Measure the width of the pupil by means of the millimeter scale in the telescope, recording it on the chart.


HAAG STREIT AG
BERN-SCHWEIZ
I1
I2
I3
I4
Pour changer de côté, faire passer l'index par ici
Für Seitenwechsel Zeiger hier durchführen
To change the side, swing index along this line
Printed in Switzerland
510-289

Nomen: M. A. 1908
Datum: 11. 7. 1953
Diagnosis: TUMOR CEREBRI STASIS PAPILLAE
4,5 mm Diameter pupillae
W R G B Color
Correctio +2.5 SPH.
OS. OD. Visus: +1.0 sph cyl o 1.0

Object	
No	mm²
O	1/16
I	1/4
II	1
III	4
IV	16
V	64
No	Relat Intens
1	0,0315
2	0,100
3	0,315
4	1,00

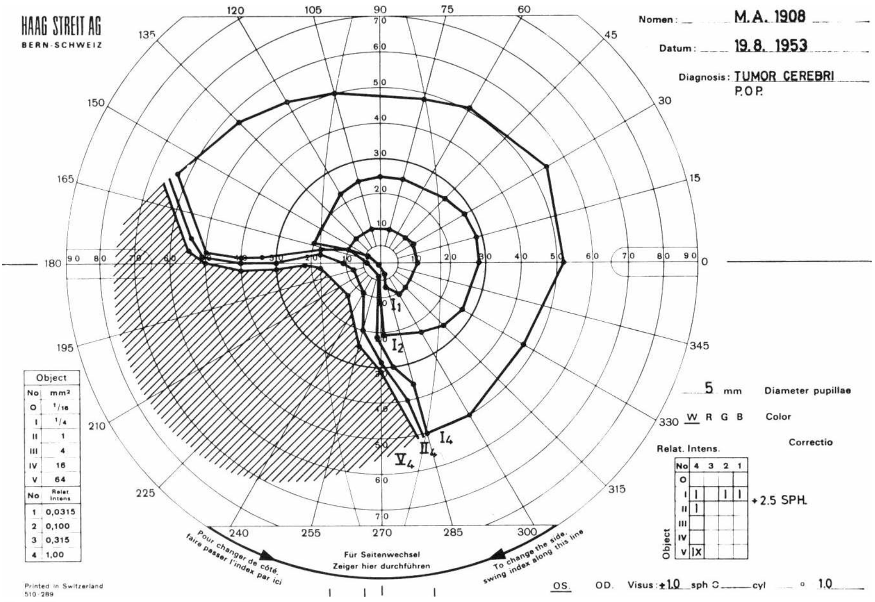
Fig. 14. Cerebral tumor in the area of the right temporal lobe


HAAG STREIT AG
BERN SCHWEIZ
I1
I2
I3
I4
Pour changer de côté, faire passer l'index par ici
Für Seitenwechsel Zeiger hier durchführen
To change the side, swing index along this line
Printed in Switzerland
510-289

Nomen: M.A. 1908
Datum: 11. 7. 1953
Diagnosis: HIRNTUMOR
4 mm Diameter pupillae
W R G B Color
Correctio S.C. +2.5 SPH.
OS. OD. Visus: +1.0 sph cyl o = 1.0

Object	
No	mm²
O	1/16
I	1/4
II	1
III	4
IV	16
V	64
No	Relat Intens
1	0,0315
2	0,100
3	0,315
4	1,00

Fig. 15. Cerebral tumor in the area of the right temporal lobe


Nomen: M.A. 1908

Datum: 19.8. 1953

Diagnosis: TUMOR CEREBRI
P.O.P.

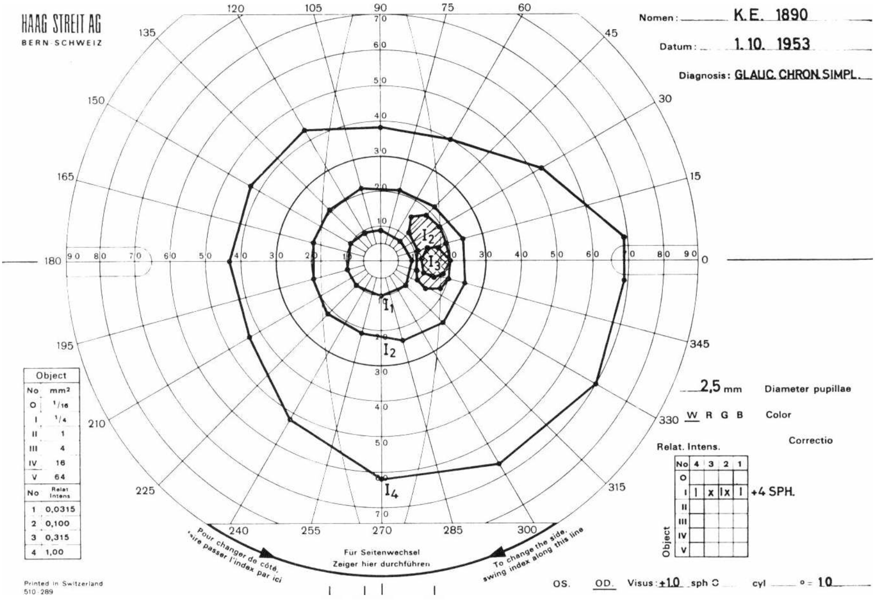
5 mm Diameter pupillae

W R G B Color

Correctio +2.5 SPH.

OS. OD. Visus: +1.0 sph ○ cyl ○ 1.0

Fig. 16. Cerebral tumor after operation


Nomen: K.E. 1890

Datum: 1.10. 1953

Diagnosis: GLAUC. CHRON. SIMPL.

2,5 mm Diameter pupillae

W R G B Color

Correctio +4 SPH.

OS. OD. Visus: +1.0 sph ○ cyl ○ = 1.0

Fig. 17. Glaucoma chronicum simplex

12. As a rule, the perimetric examination is begun with a target of size I and intensity 4 (I/4), with which the extent of the entire visual field of a normal 20–30 year old is explored (fig. 10). If a constriction of the isopter is found, the target is enlarged and examination is made with II/4, if necessary V/4 (fig. 12 and 16).

13. Move the target at a constant speed of about 1–2° a second from the periphery towards the centre, marking the threshold every 30–45° (e.g. at 0°, 30°, 60°, etc.). For a target with a smaller degree of intensity, such as I/3, the thresholds are determined on the meridians 15°, 45°, 75°, etc.. This process is repeated, with the necessary adjustments, using the targets I/2, I/1 and 0/1 (fig. 11).

14. In every case, the medial and central field of vision to a radius of about 30° is examined, after correction of any existing anomaly of refraction for a distance of 30 cm = 12 in. Correct astigmatism of more than 0.75 dptr. with cylindrical lenses. For distance-correction of patients add, for

30–40 year olds	+ 1.0 sph
40–45 year olds	+ 1.5 sph
45–50 year olds	+ 2.0 sph
50–55 year olds	+ 2.5 sph
55–60 year olds	+ 3.0 sph
over sixties	+ 3.25 sph

15. Examine the blind spot with the target whose isopter just includes the area of the blind spot (normally I/1 or I/2) or with an intensity one grade higher if the isopter passes at 20°. Using the shutter control 33, extinguish the illumination of the target before it is brought into place in the centre of the blind spot at about 15° temporarily (at 10° in aphakia).

16. For a scotoma, the borders of the scotoma shold be determined by means of a target in the area where it is believed to be situated. Approach the target vertically on the expected border. Make further tests with targets of increased intensity and later of larger size [e.g. scotoma in the area of target I/2: examination with I/2, I/3, I/4, II/4, V/4 (fig. 13)]. With Perimeter 940-K7 or 940-ST, the additional grey filters 30 may also be used.

17. Examine for paracentral scotoma by means of flashing with I/1 or 0/1.

18. Join up the points plotted on the chart during the examination. The left side of the chart corresponds to the left side of the patient's field of vision.
19. Examine the other eye.
20. Binocular examination of visual field is undertaken when there is a suspicion of simulation or aggravation, distinguishable through evidence of concentric constriction of isopters in one or both eyes without plausible explanation. First examine each eye separately, also with the largest and most luminous target. Using the telescope, determine the temporal side of eye claimed to be worse. One can then usually prove whether what is said to be the less good eye has a temporal sickle of visual field.
21. Examination of relative scotomas with the aid of the fixation point projector 53 (page 26).
22. Should there be a large distance between two isopters (e. g. I_{1e} and I_{2e}) introduce an additional grey filter with handle 29 to reach the area in between (fig. 18).

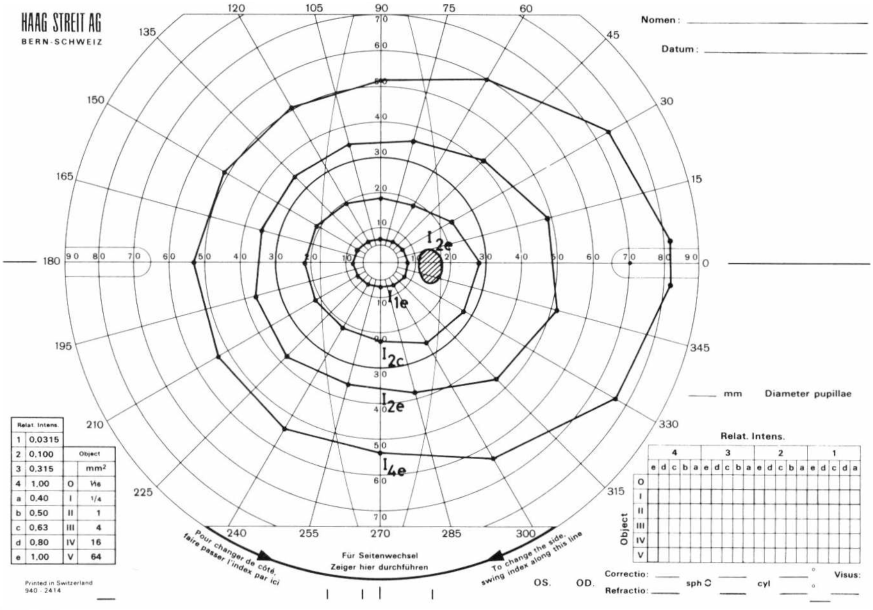


Fig. 18

Perimetry of central scotoma with the Goldmann Perimeter

Assembly

Loosen the holding screw 41 and pull the stopper plug out of the lamp housing. Insert the plug of the mobile arm in its place (fig. 19) and tighten the holding screw 41. Insert

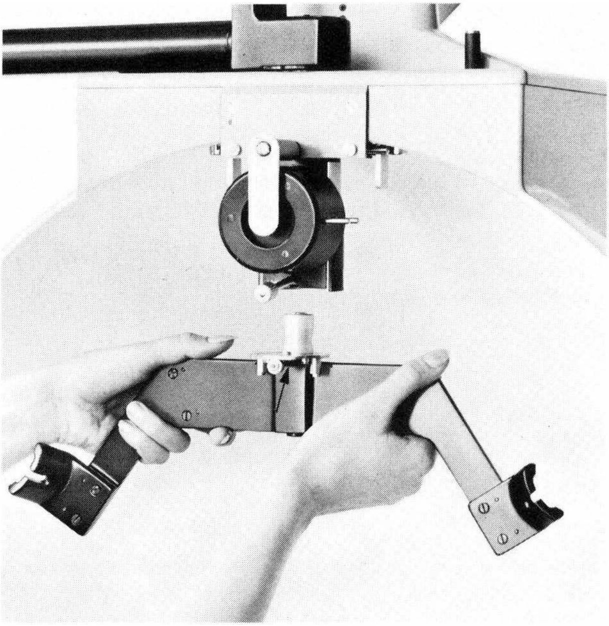


Fig. 19

the projector into either of the arm's saddle bearings and secure it by turning the projector's knurled knob. It should be held firm in the slit notch. Connect up the current at socket 2. With the mobile arm resting in the intermediate position, switch on the instrument at 35. Four luminous points then become visible in the middle of the sphere. If they are not laterally centred, insert the pin provided (it is found in the storing case) into the hole in the cam-head (fig. 19, arrowed), turning it until the four points are as directed.

General

The apparatus for examining central scotoma consists of a fixation mark projector and a mirror plate, both mounted on a mobile arm.

In addition the following accessories are needed:

1 trial frame, if necessary the support for lenses which is supplied with the perimeter,

1 Herschel rotary prism, and trial lenses.

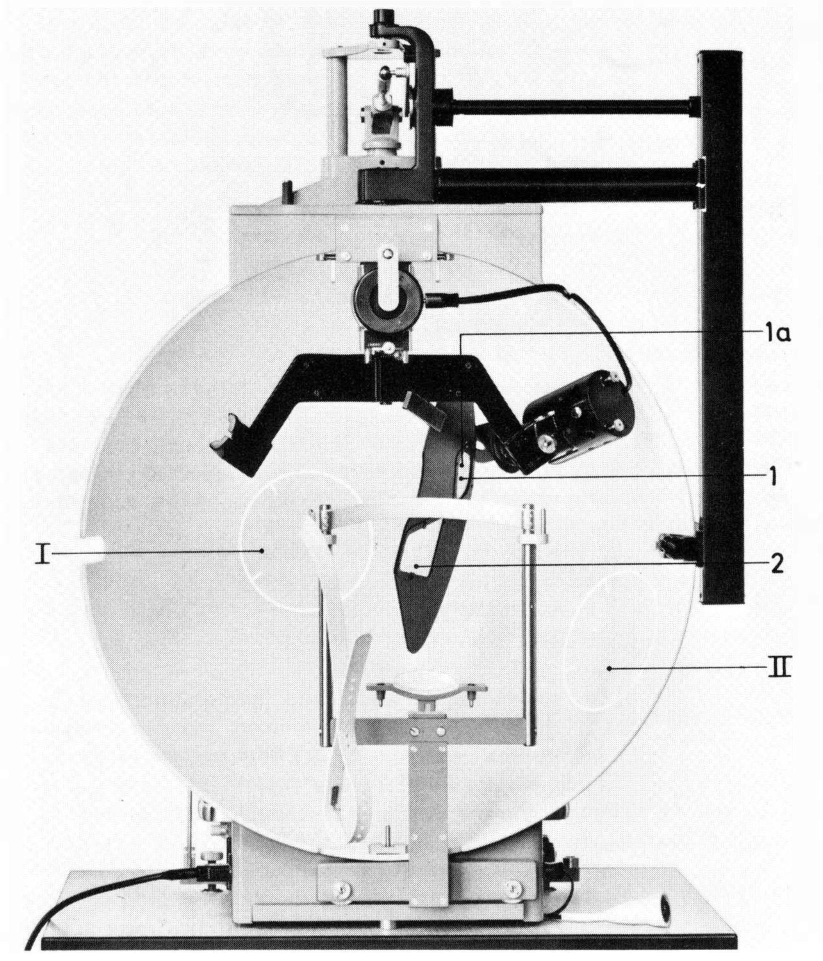


Fig. 20

The mirror plate hung in the sphere of the perimeter separates the visual field of the non-examined or fixating eye from the eye to be examined. The superior part of this plate has a semi-transparent mirror 1 (fig. 20), the central part of which contains a small opaque mirror 1a. An ordinary mirror 2 is placed below, at the level of the patient's eye. The projector sends through the semi-transparent mirror 1a circle I of 15° radius and, simultaneously, by reflection a second circle II coincident to circle 1 on the lateral periphery of the sphere. Circle I is seen only by the eye examined, and circle II is seen only by the fixating eye in the ordinary mirror 2. The small opaque mirror 1a reflects the fixation point (five points in the form of a cross) into the middle of circle II. If the patient fixates this point (cross) and sees only one circle with both eyes because of fusion (the examined eye circle I, the fixation eye circle II), then the examined eye must of necessity be directed to the centre of circle I.

Principle

The apparatus permits kinetic perimetric examination of one eye, while the other maintains fixation. The examined eye is kept steady by fusion, each eye seeing only one circle. The lateral positioning of the projected circles also aids in recognising very small relative central scotomata.

Examination

Before examining the visual field, the refraction and visual acuity of each eye has to be checked. It is also necessary to confirm the possibility of any heterophoria at 30 cm = 12 in. with the aid of the Maddox-Wing Test or a similar device. If the routine ophthalmological examination, including perimetry, indicates the possibility of a central scotoma, the accessory device is necessary to determine the exact limits of the scotoma. To examine the right eye, set up the projector and the plate on the left side of the mobile arm. Introduce mirror 1 into the mirror plate so that the white points on the mirror frame and in the mirror plate are juxtaposed and visible to the patient. The trapezoid cover plate should be mounted on the side of the sphere behind mirror 2. To examine the other eye, switch the projector and the mirror plate to the other side. The semi-transparent mirror 1 and the trapezoid cover plate must also be set up on the proper side. The target luminance has to be adjusted again to 1000 asb. by means of the lightmeter and resistance. The balance between target and background, by means of the photometer, has also to be re-set.

If necessary, trial lenses corrected for a distance of 30–35 cm = 1–13 in. are placed in front of the patients's eye. The mobile arm with the projector and mirror plate is then placed at 15° to the left or right. The fixation point, that is to say the centre of the visual field, is thus placed 15° alongside the opening of the observation telescope.

The eye to be examined is then centred as usual and the visual field chart moved 15° toward the side of the eye. (Markings indicte 15° to the left and right of the 0° position.) The Herschel rotary prism is placed in front of the patient's fixating eye and the diaphragm of the projector turned until circle II disappears. The position of the fixation point in circle I is determined through questioning the patient (the patient sees only the five-point cross with his fixating eye and circle I with his other). The heterophoria can be corrected by the patient or by the examiner through adjustments to the Herschel prism until the five points appear in the centre of the circle. The patient's directions should be checked several times. The diaphragm of the projector is then turned so that the fixating eye again perceives circle II. Both circles I and II are now seen as one in binocular vision. After these preparations, the central area of the visual field within a range of 30° is given the usual perimetry.

What cases should be examined with the central scotoma device?

1. Patients with absolute unilateral scotoma. (These patients do not perceive the point of fixation in the middle of the sphere of the V/4 target placed near the point of fixation, when they are looking straight ahead.) The fixating eye must be able to recognise the fixation marks of the central scotoma device (the five points) as well as the circle II. When the scotoma has a radius of more than 15° the eye under examination does not register circle I. In this

case, the examiner redirects the fixating eye with the aid of the Herschel prism so that the examined eye appears centred in the telescope.

2. Patients who have a small relative central scotoma, with a radius of up to 5°, on either or both sides.
3. Patients with small paracentral scotomata.

What patients cannot be examined by this method?

1. Patients without binocular vision.
2. Patients with bilateral central scotoma who do not recognise the fixation marks (none of the five points). In this case an attempt is made to redirect and maintain the eye in a good position. Normal perimetry, without the central scotoma device, is then performed.
3. Patients with a relative central scotoma of more than 5° radius who can still recognise the fixation point (mirror or black spot in the centre of the perimeter bowl). Normal perimetry is carried out or perimetry with the aid of the fixation point projector 53.
4. Patients who have a strabismus of more than 10°.
5. Patients with abnormal retinal correspondence; there is the possibility that the scotoma found are only functional.

Changing the incandescent bulb

An incandescent bulb, 6 V, 4.35 A with centring base, of the same type as in the main appliance, is used in the lamp housing of the projector for the central scotoma device. The bulb is made accessible by loosening the two knurled knobs at the base of the housing.

Perimeter 940-ST

Assembly

Fit arm (55) for static perimetry to end of pantograph and fasten with coupling 20. Clamp telescopic magnifier 58 by perimeter aperture 44 so that it points towards photometer ring 45 (see page 8, fig. 8).

Registering plate 51 (Fig. 25)

This consists of:

a) plexiglass plate with indication of meridians in steps of 15°
b) ruler for setting meridians
c) slide for degree adjustment
d) intensity scale
e) 2 orientation pins.

The chart is fastened to the registering plate as follows: The fixing spring of ruler b) is slightly lifted and the two centring pins of the fixing spring are inserted into the two holes in the chart. The registering plate is placed in front of the opal chart plate 21 and fastened with four catches. The registering plate can be placed on the left or right side of the opal plate, depending on whether the orientation pin e) is in the left or right hole in the back of the perimeter above the left-hand slide 15.

In the left-hand position, the centre of the chart (0°) coincides with the centre of the sphere, and in the right-hand position with the auxiliary fixation point which is projected 5° to the side by the fixation point projector 53.

On the intensity scale d) letters and figures are engraved in colours corresponding to the symbols of the grey filters and their combinations (see page 6, fig. 6). The brightness of these combinations can be read on the right or left margin of the chart. The position of the right-hand edge of the intensity scale d) indicates on the chart the position of the test target in degrees from the centre (0°).

Fixation point projector 53

Loosen the holding screw 41 and pull the stopper plug 54 out of the lamp housing. Insert the plug of the fixation point projector in this opening and tighten the holding screw (fig. 21). The main bulb of the perimeter also serves as a source of light for this projector.

To check centering: Put registering plate 51 with chart into right-hand position in front of chart plate 21. Place slide 51c on 0° (fix exactly in notch). Move projector 3 to side of lightmeter and insert pin of arm 55 into hole in slide 51c. Set target 4 mm² (III) with intensity 4e. Turn milled screw 62 (fig. 22) fully to the right until the one-point target is projected. Should this target not be exactly

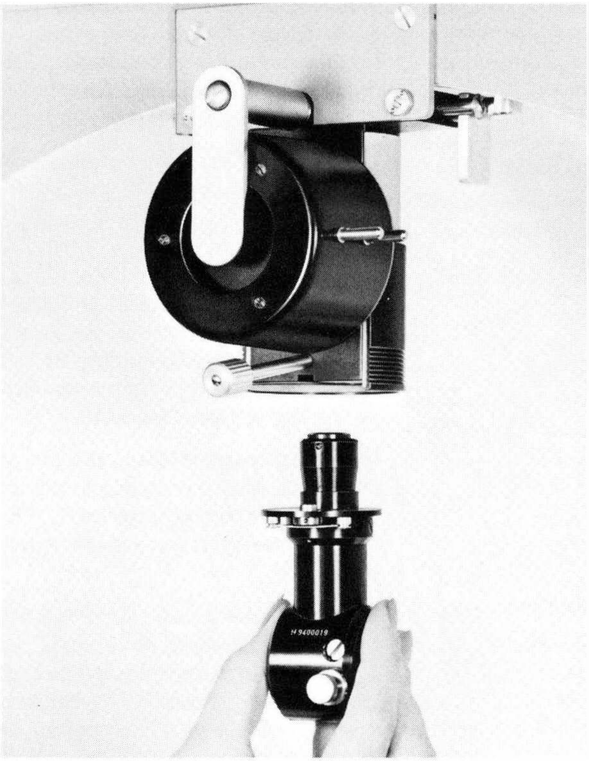


Fig. 21

centred, first make lateral correction. Place pin 52 into hole in cam-head 63. Turn the eccentric head until fixation point and target coincide.

To adjust height: Loosen nut 65 with pin 52, then turn milled screw 64 until the two points are centred. Retighten nut 65.

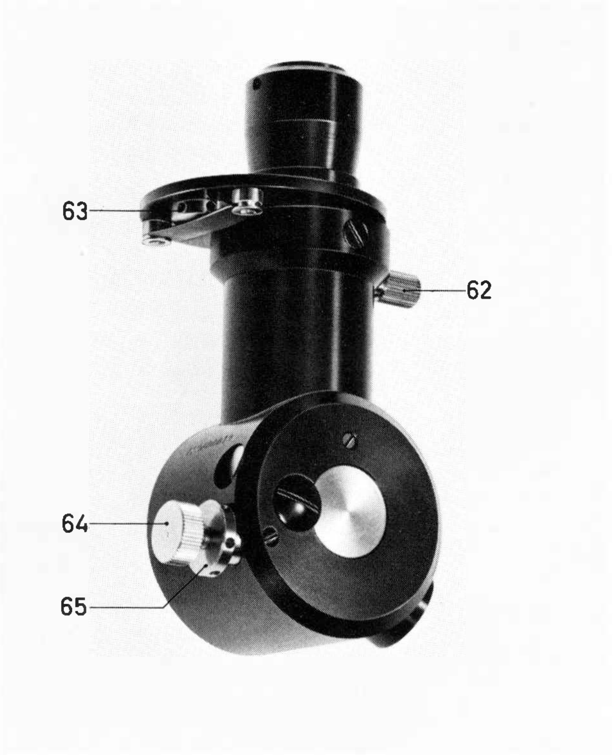


Fig. 22

Examination

(static-quantitative perimetry or profile perimetry)

In the static-quantitative method of light-perception perimetry, the differential or contrast threshold for light perception is examined with a fixed target. The differential thresholds are examined on one or more meridians at any point desired. Contrast sensitivity curves are thus obtained.

After examining several meridians, a three-dimensional visual field cone can be constructed, enabling sensitivity differences in the entire field of vision to be very accurately judged. As static-quantitative examination of the entire visual field takes a great deal of time, examination is often confined to one or two promising meridians, chosen as likely to provide the maximum information on the basis of the kinetic-quantitative perimetry results. With the Goldmann perimeter, kinetic-quantitative and static-quantitative perimetry are carried out under the same examination conditions.

The instrument can be adjusted for the desired examination method with little trouble, and is therefore useful not only for scientific examination but also for daily use in clinics and medical surgeries.

The combination of kinetic-quantitative and static-quantitative perimetry is certainly the best way to obtain accurate information on the state of visual perception. The effectiveness of the treatment employed can be checked in a very short time with a few examinations by the static-quantitative method, indicating any progression or remission of a pathological condition of the sense of light perception.

The following procedure is recommended for examination by the static-quantitative method:

1. Allow 2 to 3 minutes for patient to adapt to illuminated perimeter.
2. Roughly adjust head-rest. For examination of right eye, head-rest is on patient's left.
3. Cover eye not being tested with opal occluder.
4. Set ruler 51b on meridian 0–180°.

5. Fix chart on registering plate.
6. For examination of the centre of the field, place registering plate in right-hand position in front of opal plate of perimeter.
7. Adjust target and sphere brightness with lightmeter and photometer (see page 8, fig. 8: Obtaining normal brightness of target and sphere). With background luminance level of below 1 asb., photometer must be observed through telescopic magnifier 58.
8. Fasten arm 55 for static perimetry to end of pantograph.

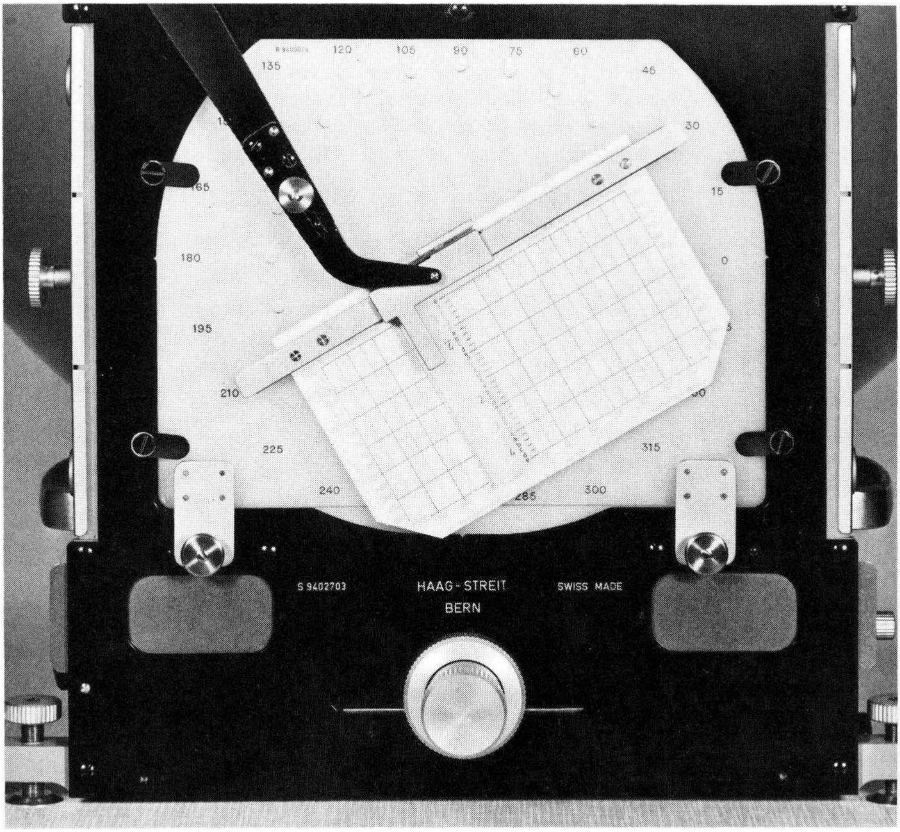


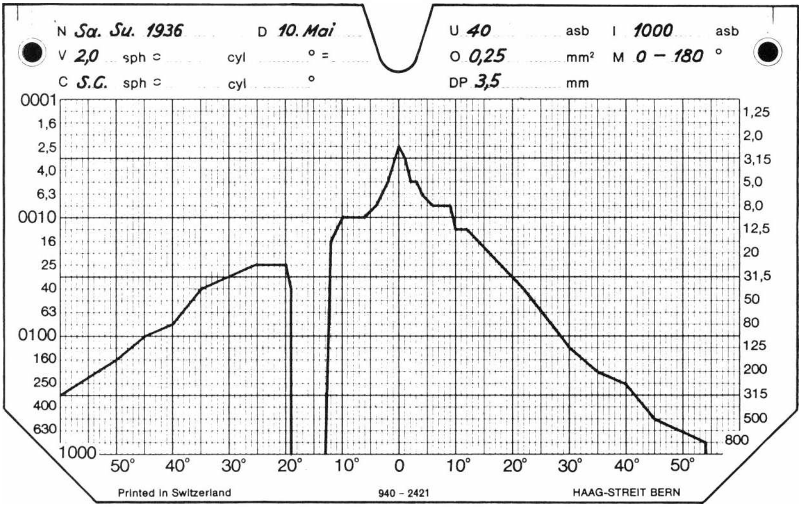
Fig. 23

9. Insert pin at end of pantograph into hole in slide 51c.
10. Choose meridian to be examined (fig. 23). Place right-hand edge of intensity scale 51d in centre of chart (0°).
11. Remove stopper plug 54 from lamp housing. Insert fixation point projector from below into lamp housing and fasten with holding screw 41. Fix the two polaroid push-on filters 57 on to objective of fixation point projector. Adjust luminosity of fixation point to visual acuity of patient by turning one of the polaroid filters.
12. Check centring of one-point fixation mark of fixation point projector 53 (see page 26: Fixation point projector).
13. Centre patient's eye exactly by turning the two milled knobs 16 and 17.
14. Measure diameter of pupil with scale in telescope. Note result on chart.
15. For examination up to 30°, correct for near vision, if necessary, by placing correction lens in front of patient's eye.
16. Select size of target, e.g. I.
17. Explain procedure to patient in simple words he can understand.
18. Turn milled screw 62 fully to right until four-point mark of fixation point projector is seen. Ask patient to look into the middle of this mark. Present a supraliminary target so that patient sees where target will appear.
19. Turn shutter 33 in such a way that target is not projected inside sphere and, therefore, no light appears in checking-aperture 26.
20. Set an infraliminary target intensity, e.g. with sphere at luminance level of 31.5 asb. and target size of I, use filter combination 2d and filter D = 0.01 of filter plate 30. Target luminance is 0.8 asb. The target will not be perceived by a patient of normal visual acuity.
21. Present target for one second; target is projected by pressing down lever 33.
22. Allow an interval of three seconds to avoid local adaptation.
23. Set next filter combination 2e and present for one second. Then again leave a three-second interval, and so on.

24. Patient indicates by pressing buzzer when he has just perceived target. Next lower intensity is then presented again, and in most cases this lower intensity can now also be seen. With larger targets and reduced sphere luminance, differences in luminance of 10% can be distinguished. In these cases push-on filter 56, D = 0.9, should thus be used.

25. If patient does not perceive filter combination 4e with filter D = 0.01, use position D = 1.0 of filter plate 30 and combination 1a = 12.5 asb.

26. Mark target luminance on chart. Lateral marking place is given by position of right-hand edge of intensity scale 51d. Mark combination of filters presented with pointed pencil in intensity scale serrations. Letters and figures engraved on this scale correspond to position of handles 28 and 29 at back of perimeter. Horizontal line over figures 3 and 4 on scale indicates that filter D = 0.01 is inserted with handle 30, e.g. 4a. Luminance corresponding to filter combinations, e.g. 4a = 4 asb. and 4a = 400 asb., are indicated on left or right margins of chart.



N Sa. Su. 1936
D 10. Mai
V 2,0 sph ⊃ cyl ° =
C S.C. sph ⊃ cyl °
U 40 asb
I 1000 asb
O 0,25 mm²
M 0 – 180 °
DP 3,5 mm

Fig. 24. Normal profile of a 20-year-old person

27. For examination of area immediately surrounding centre of visual field and up to 3° on either side patient looks at one-point mark projected into sphere by fixation point projector 53.

28. Beyond 3°, ordinary fixation point in centre of perimeter sphere is used.

29. Fixation point projector is removed or fixation point extinguished by turning one polaroid filter.

30. Place registering plate 51 in left-hand position, where it is centred with respect to normal fixation point in middle of sphere.

31. As soon as inner registration limit of pantograph is reached, swing it to the other side by guiding it along lower edge of registering plate (as for kinetic perimetry).

32. If an initial luminosity other than 1000 asb. is used, multiply figures on chart margin by initial luminosity and divide result by 1000. Two charts must be stapled together if more than 3 powers of 10 are required for registering thresholds. The charts can be used for any measuring range. Record correct luminosity levels by appropriate placing of decimal points.

33. In routine examination, it is recommended that threshold of following points be determined: 0°, 1°, 2°, 3°, 5°, 10°, 15°, 20°, 25°, 30°, 40°, 50°, 60°. Borders of blind spot and scotoma are examined degree by degree until normal threshold level is reached.

34. By connecting thresholds, thresholds or sensitivity curves are formed (fig. 24).

35. Following entries are made on chart: N = name, D = date, V = visual acuity, C = correction, DP = pupillary diameter, U = background luminance, O = size of object, M = meridian, I = initial luminance.

Bibliography

Harms, H., Die praktische Bedeutung quantitativer Perimetrie. Klin. Mbl. Augenheilkunde 121, 683–692 (1952).

Weekers, R. et Lavergne, G., Applications cliniques de la périmetrie statique. Bull. Ser. belge Ophtal. 119, 418–430 (1958).

Sloan, L. L., Area and luminance of test object as variables in examination of the visual field by projective perimetry. Vision Research 1, 121–138 (1961). Pergamon Press. Printed in Great Britain.

Maintenance

All moving parts have been lubricated by the manufacturer for many years of service. Only the two ball joints of the swinging rod above the instrument, connecting the pantograph to the projector, may need an occasional drop of thin oil, perhaps twice a year. As for the lamp housing, it is mainly the lower surface of the condenser lens which collects dust as a result of the circulation of warm air. To clean it, remove the cable for the main bulb, press the flanges 38 inwards and remove the housing by pulling downwards. After releasing the flanges, the condenser can be taken out and the lens cleaned with a soft linen cloth. When replacing the condenser, make sure the red marks are in line. For assembly, see 'Instruction for assembly' (fig. 3).

Dirt may also collect between the sliding diaphragm 40 and its cylindrical sliding surface on the lamp housing and obstruct the movement. To clean, take off the diaphragm by pulling it downwards. (If necessary first remove the fixation point projector or the device for examining patients with central scotoma.) Wipe both sliding surfaces with ethyl alcohol. The white plastic foil is now loose in the sliding diaphragm. When assembling take care that the sliding foil lies exactly between the protruding edges of the sliding diaphragm. The latter has to be slightly expanded to be returned to its sliding rail in the lamp housing.

For cleaning the white inner surface of the sphere we supply the necessary utensils with every instrument. Instructions for use are printed on the box of the 'Duponol' cleaning agent. The small white photometer screen can be pulled out downwards for cleaning, though the spring stop offers a certain resistance.

On the inside:

Picture of accessories for Perimeter 940-ST

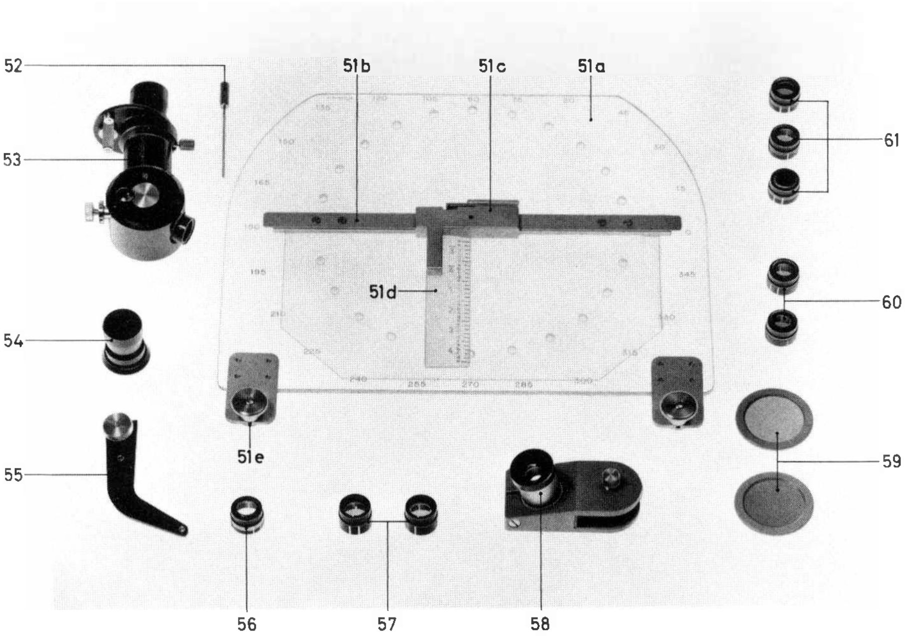


Fig. 25

Terms figure 25

51 Registering plate with
  a) plexiglass plate
  b) ruler
  c) slide
  d) intensity scale
  e) orientation pin
52 Adjusting pin
53 Fixation point projector
54 Stopper plug
55 Arm for static perimetry
56 Push-on filter, transparency = 0.90 (broad white band)
57 2 polaroid filters for fixation point projector
58 Telescopic magnifier with holder

Filters supplied only on special request (not included in the standard equipment 940-ST):

59 2 insert filters, red and green, complementary colours, diameter 38 mm
60 2 push-on filters, red and green, complementary colours (narrow red and green band)
61 3 push-on filters, red, green, blue (broad coloured band)

Printed in Switzerland